



Armed Forces College of Medicine AFCM





Skeletal Muscle Fibers (1)

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Intended Learning Objectives (ILO)



By the end of this lecture the student should
be able to:

- **Describe** the microscopic structure of skeletal muscle fibers.
- **Correlate** the structure to the function of the skeletal muscle fibers.



Key Points



- ❑ **General criteria of the muscle tissue (origin, classifications, types).**
- ❑ **Skeletal muscle:**
 - **Development and differentiation.**
 - **Organization (C.T. coverings).**
 - **L.M. of skeletal muscle fibers (shape, cytoplasm, N.)**
 - **E.M. of skeletal muscle fibers (=myo-**fibers**) and myo-**fibrils**.**
 - **Correlated functions of the sarcomere**
 - **Structures of myo-**filaments**.**

Muscle Tissue

Origin:

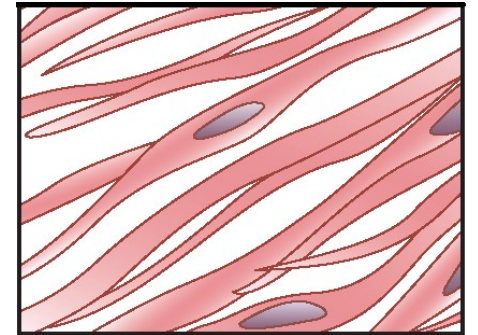
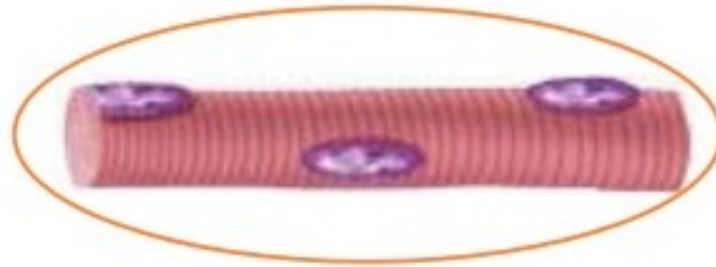
- **Mesodermal** in origin.
- Muscle of the iris & myoepithelial cells:
ectodermal in origin.



Classification of Muscles

1. According to **morphology**:

- A. Striated
- B. Non-striated



2. According to **function**:

- A. Voluntary
- B. Involuntary



Types of Muscles



- **Skeletal Muscle**



Voluntary Control

Striated

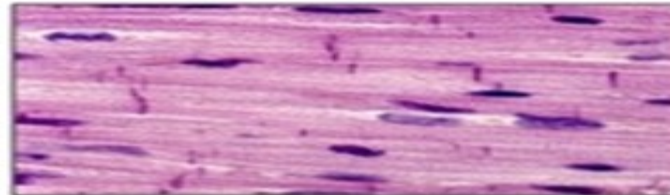


- **Cardiac Muscle**



Involuntary Control

Striated

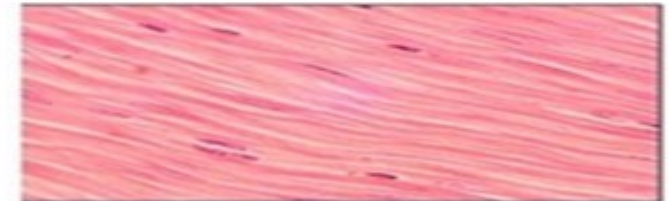


- **Smooth Muscle**



Involuntary Control

Non-striated



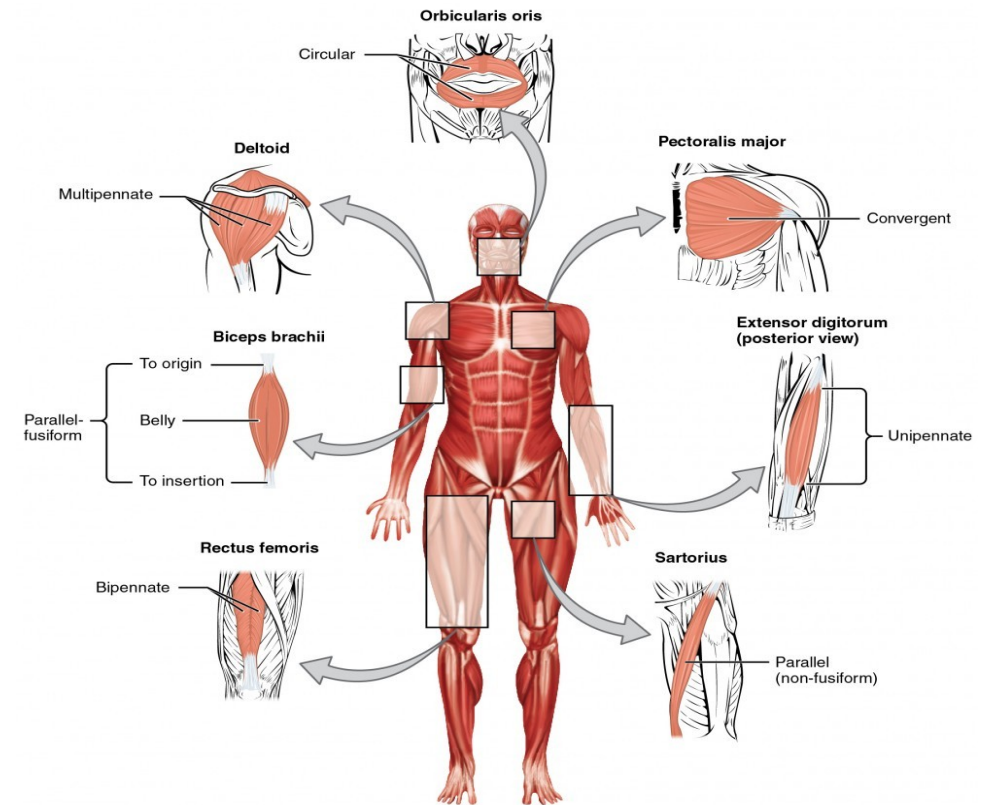
Skeletal Muscle



- Muscle responsible for voluntary movement.

Sites:

1. Muscle attached to **skeleton**.
2. **Tongue & face** (branched sk.m.)
3. Muscle of **upper 1/3 of oesophagus** – m. of



https://lh3.googleusercontent.com/FOWKHIm5gkbnBfIQ4vJgYpRRZMWAZK5MeqtLx_1Dw05JCsjrkj1XD38pkPFJSFuKLqTFsQ=s101



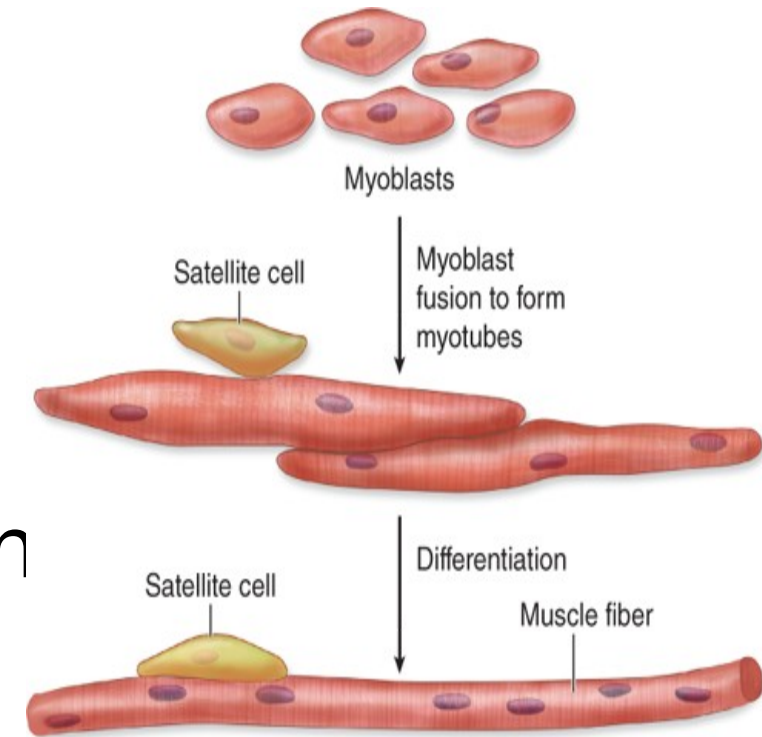
Skeletal Muscle



Origin:-

1) Prenatal life: Myoblast (fusion of many cells)

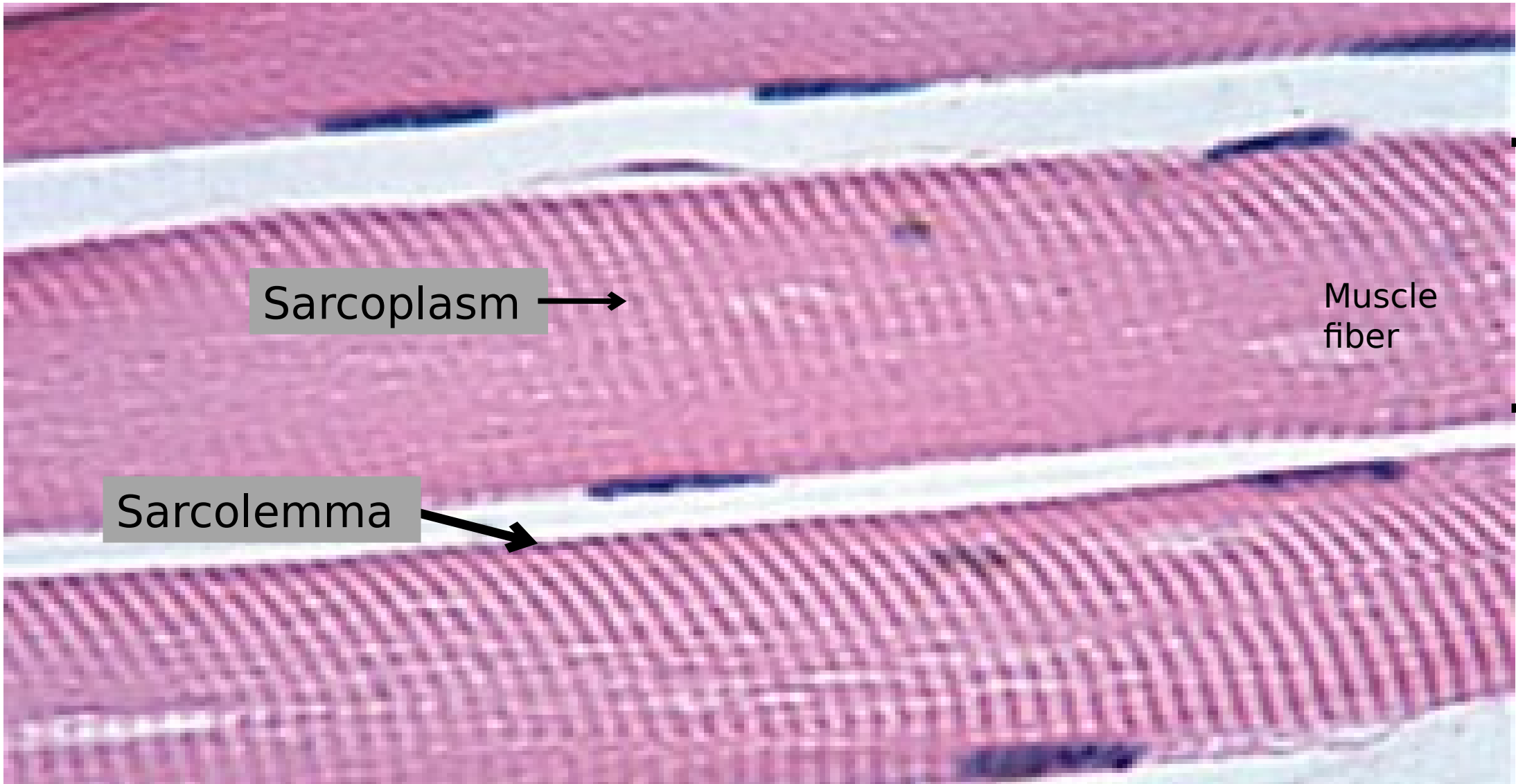
2) Postnatal life: Satellite cell (mononucleated flattened cells present between the cell membrane and the basement membrane).



Source: Anthony L. Mescher: Junqueira's Basic Histology: Text and Atlas, 15th Edition. Copyright © McGraw-Hill Education. All rights reserved.

Regeneration of skeletal muscle occurs by satellite cell.





[https://www.google.com.eg/url?
sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjD29iRpjHiA
hUESxoKHbVdDhMQjRx6BAgBEAU&url=http%3A%2F%2Fiwate-kokyo.info%2Fimageimgkl-
muscle-cells-under-a-
microscope.shtm&psig=AOvVaw0fa0ROpHhFkGtjY1exfWF5&ust=1557588659911241](https://www.google.com.eg/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjD29iRpjHiAhUESxoKHbVdDhMQjRx6BAgBEAU&url=http%3A%2F%2Fiwate-kokyo.info%2Fimageimgkl-muscle-cells-under-a-microscope.shtm&psig=AOvVaw0fa0ROpHhFkGtjY1exfWF5&ust=1557588659911241)

Musculoskeletal Module



Microscopical characters of skeletal muscle



- 1) It is formed of Muscle Cell (Muscle fiber)
- 2) The plasma membrane is called Sarcolemma.
- 3) The cytoplasm is called Sarcoplasm.
- 3) Sarcoplasm contains {myofibril-sER-mitochondria-myoglobin} to serve its contractile function.
- 4) SER is called Sarcoplasmic reticulum.



Lecture Quiz



1. Striated muscles include and

..... .

**2. Skeletal muscle fibers develop by fusion
of**

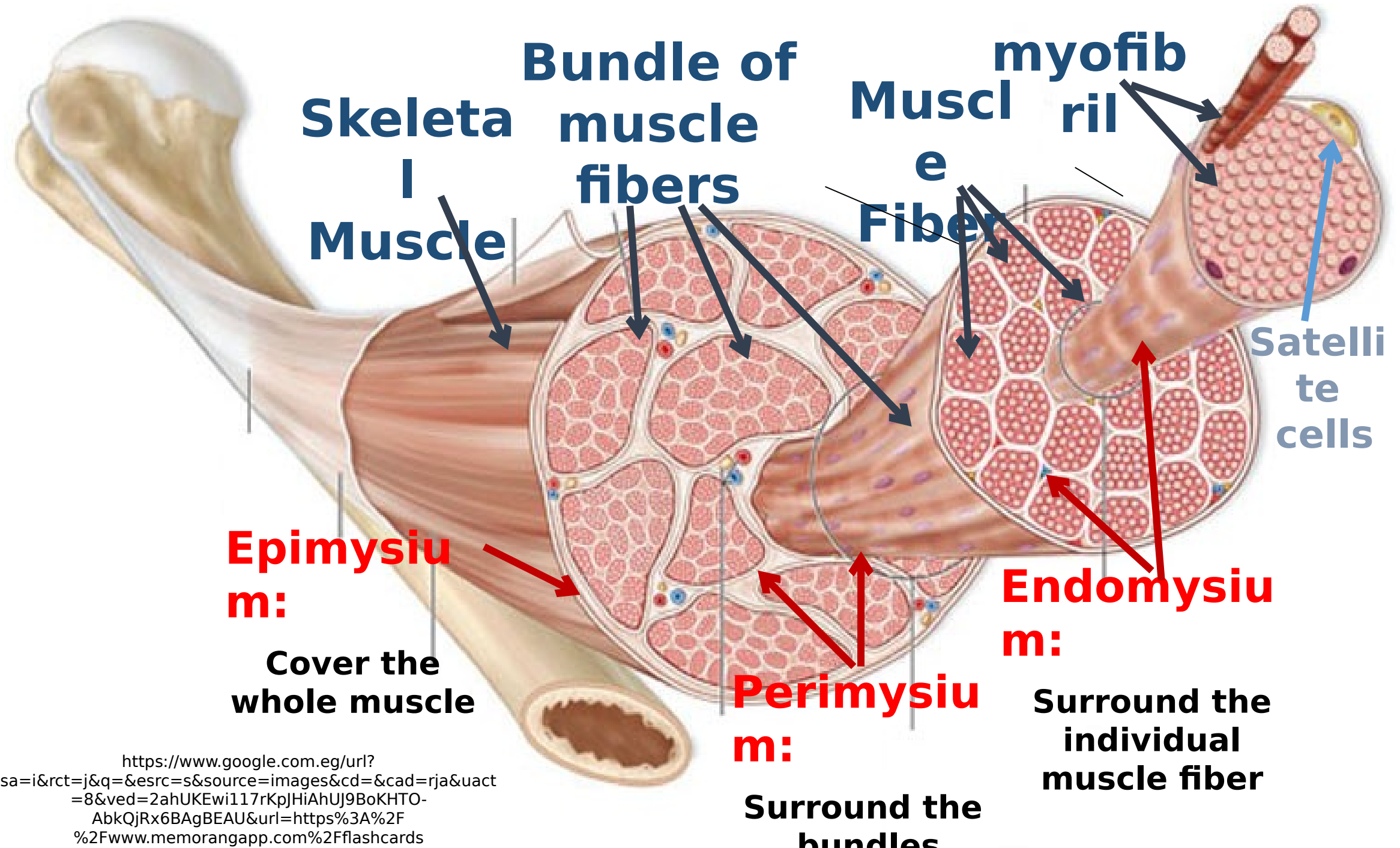
3. Sarcolemma is

Connective tissue of skeletal muscle

- 1) **Epimysium**: dense CT covers the whole muscle.
- 2) **Perimysium**: dense CT surrounds each muscle bundle.
- 3) **Endomysium**: loose CT surrounds individual muscle fibers.

Function: it contains blood vessels & lymphatic & nerves



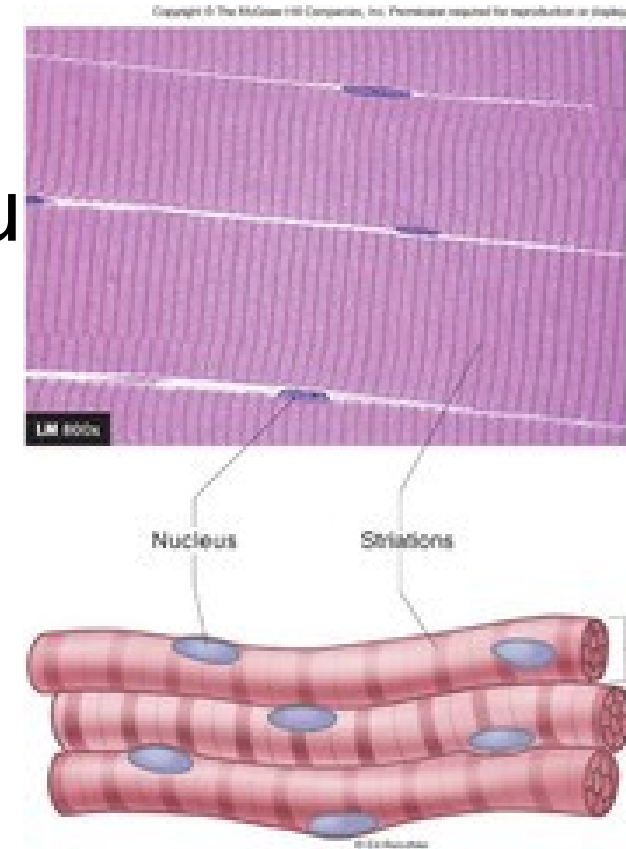


Muscle Fiber (Light microscope)



1. Shape:

- Cylindrical, long, non branched muscle fiber **except ?**
- It is variable in length (1-40 cm).
- It has wide diameter (10-100 μm)

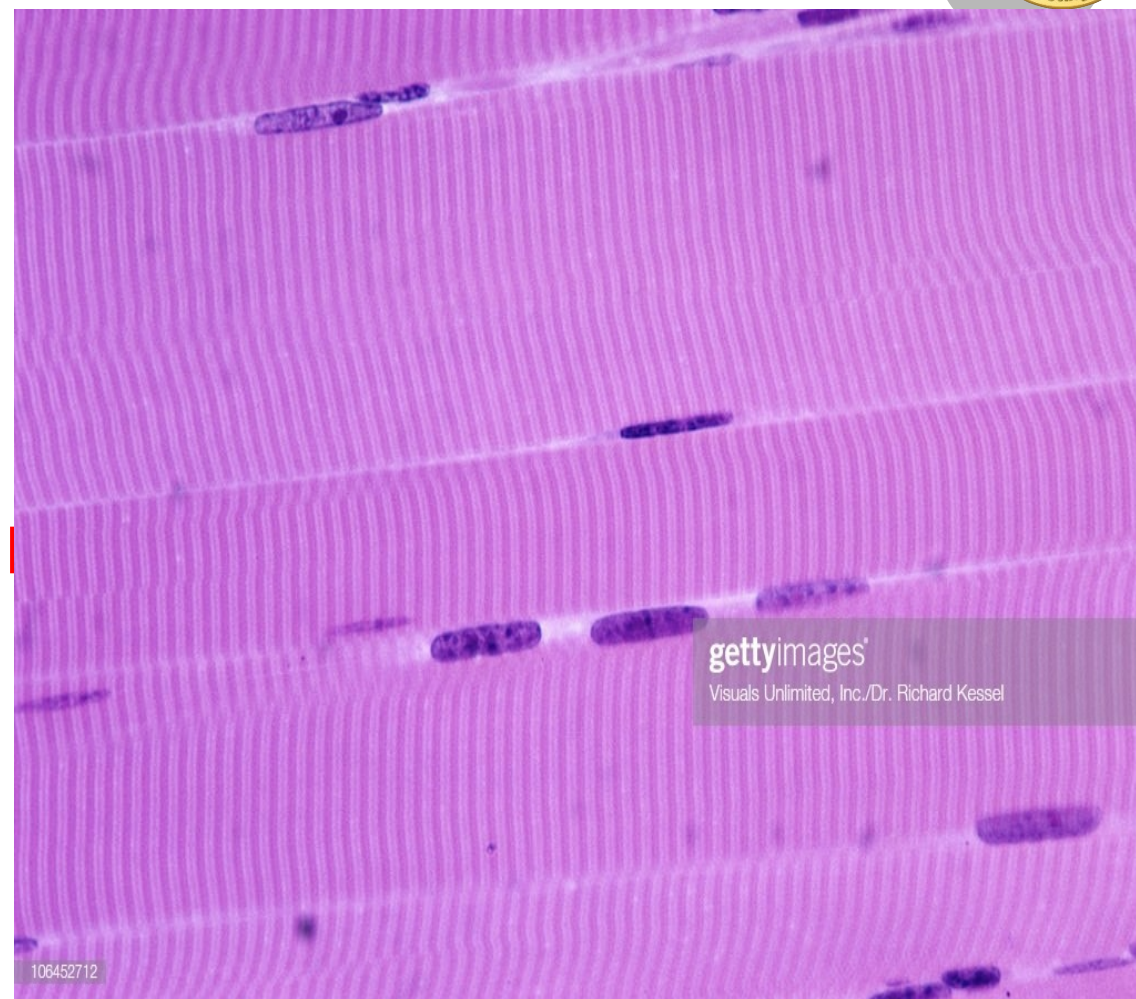


<https://healthdocbox.com/Exercise/73241264-Chapter-7-the-muscular-system-most-abundant-tissue-600.html>



2.Cytoplasm (Sarcoplasm):

- It is **deeply acidophilic**.
- It shows a **distinct striation**
- It is rich in **myoglobin & glycogen**.



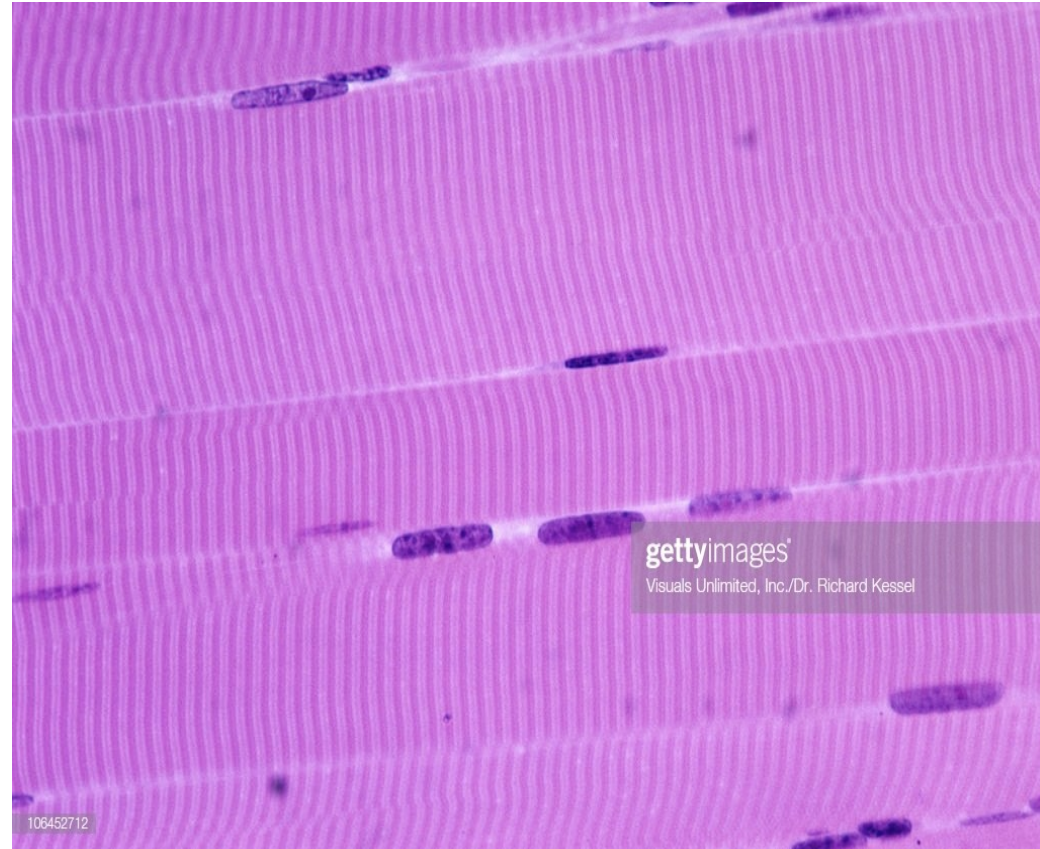
<https://i2.wp.com/media.gettyimages.com/photos/longitudinal-section-of-several-normal-human-skeletal-muscle-fibers-picture-id106452712?s=170667a>





3. Nucleus:

- Multiple.
- Rod like or ovoid.
- They are peripherally situated under sarcolemma and parallel to it.

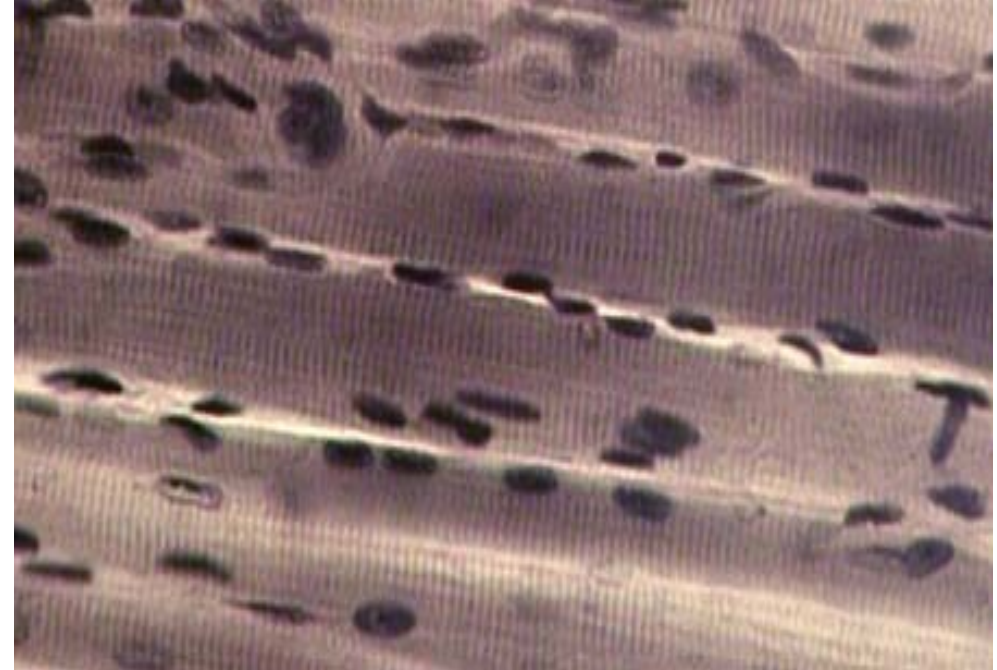


Skeletal Muscle (L.S.)



- Longitudinal cut muscle fibres show:

The muscle fibers are long cylindrical with rounded ends. They show cross striations.



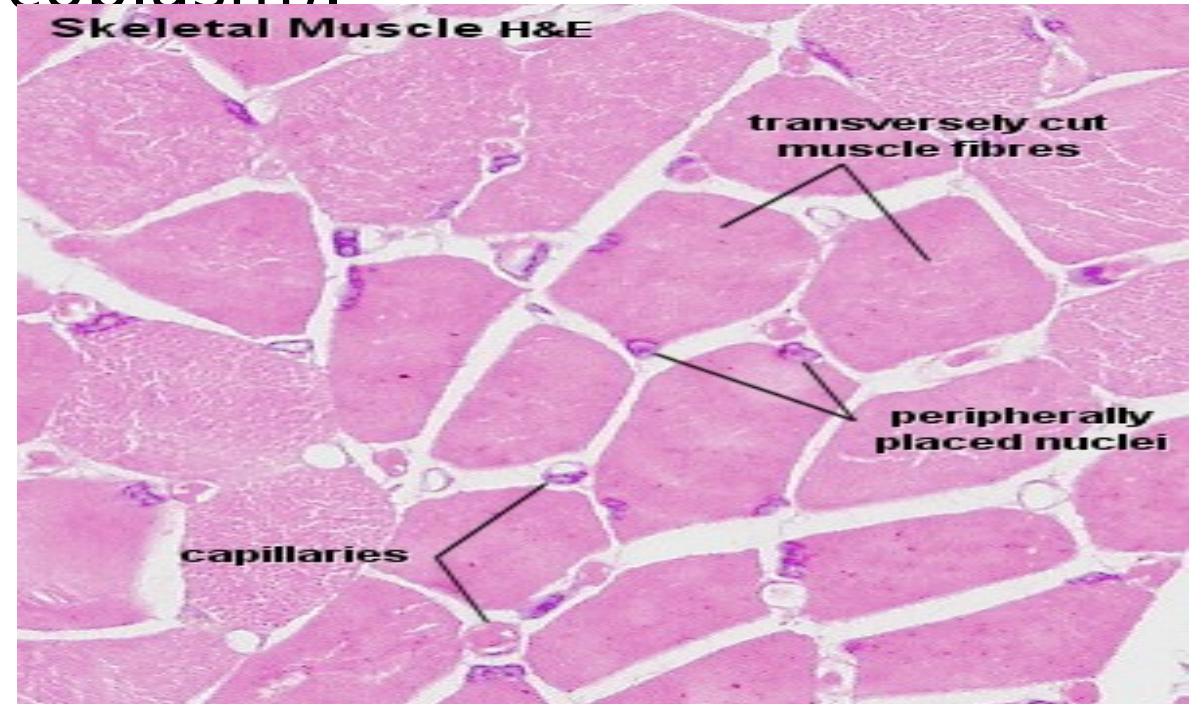
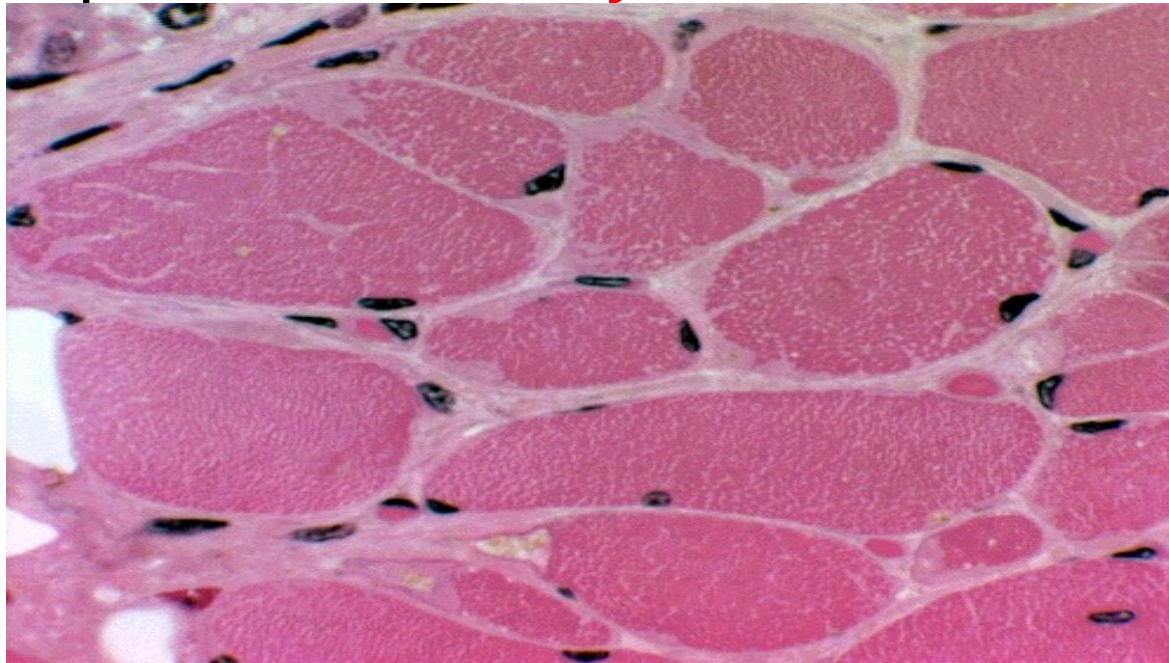
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T.S. of Skeletal muscle fiber:



- Rounded or polygonal with peripheral nuclei.
- Each muscle fiber is surrounded by B. M.
- Muscle fiber shows **Cohnheim's area** (dark acidophilic dots represents the **myofibrils** in the saroplasm).



Lecture Quiz



1. Muscle cells are also known as?

A. Myofibrils B. Myofilaments C. Muscle Fibers D.
none of the previous.

2. C.T. surrounding the muscle bundle:

A. Epimysium B. Perimysium C.
Endomysium

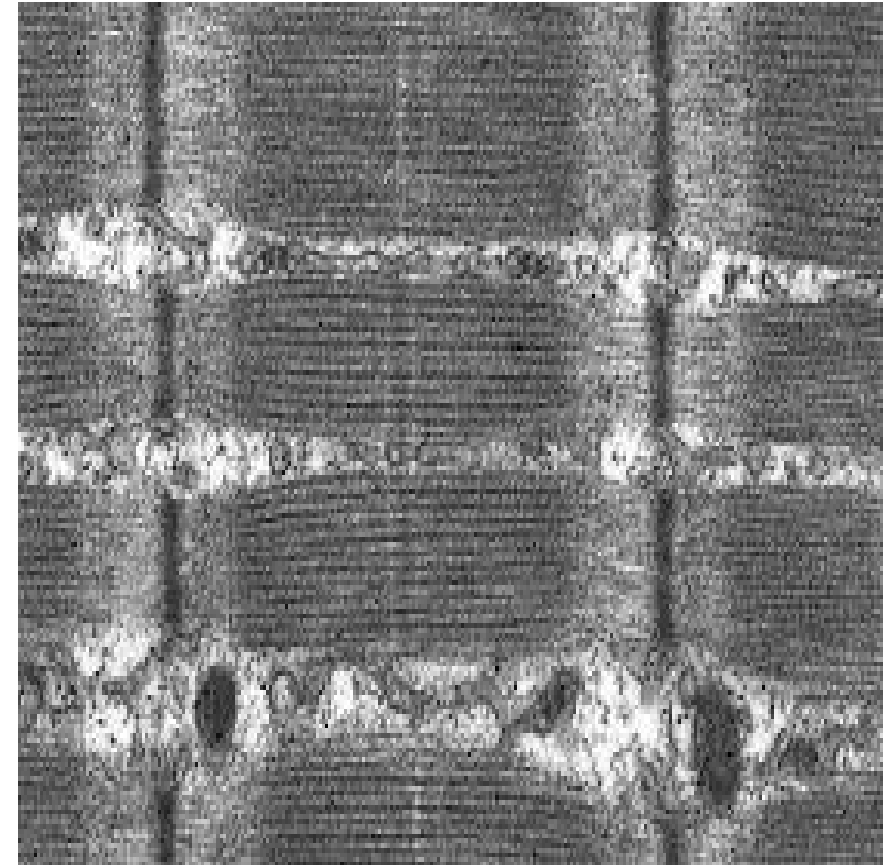
3. T.S section of skeletal muscle display:

A. Cross striation B. Cohnheim areas.

Muscle Fiber (Electron microscope)



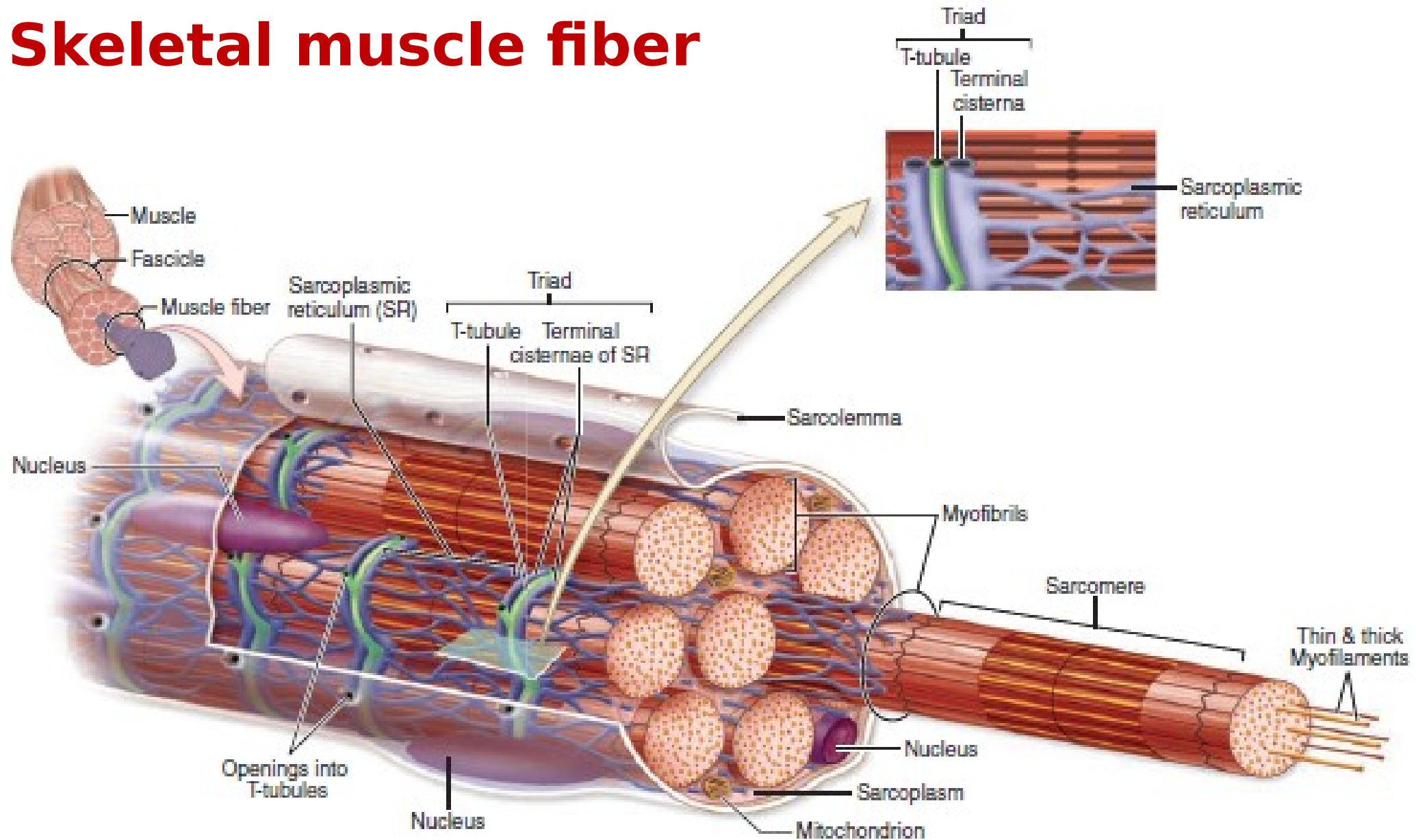
1. Myofibrils & myofilaments
2. Sarcolemma & transverse tubules
3. Sarcoplasmic Reticulum
4. Mitochondria & Golgi & Ribosomes
5. Inclusions: myoglobin & glycogen



<http://www.bu.edu/histology/i/2160300a.jpg>

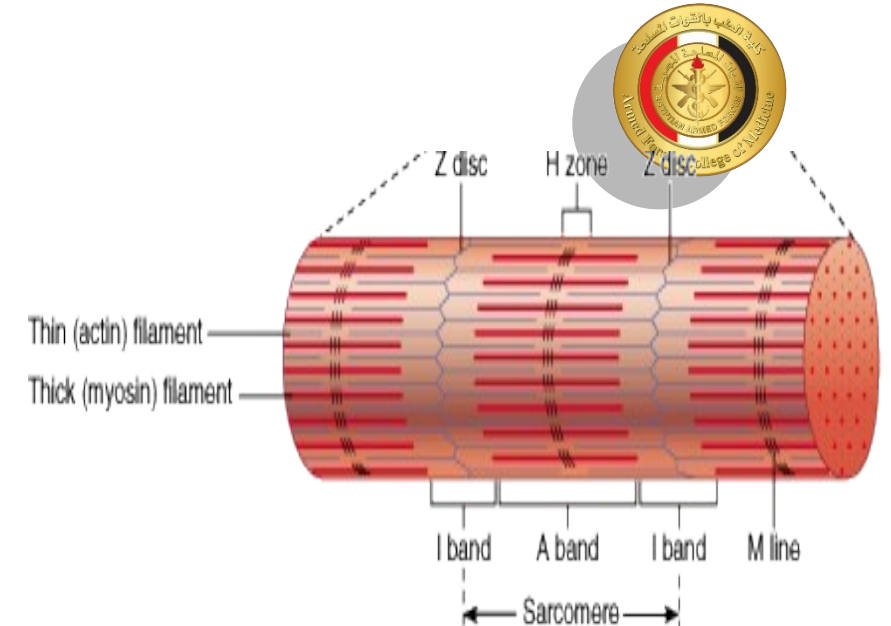


Skeletal muscle fiber

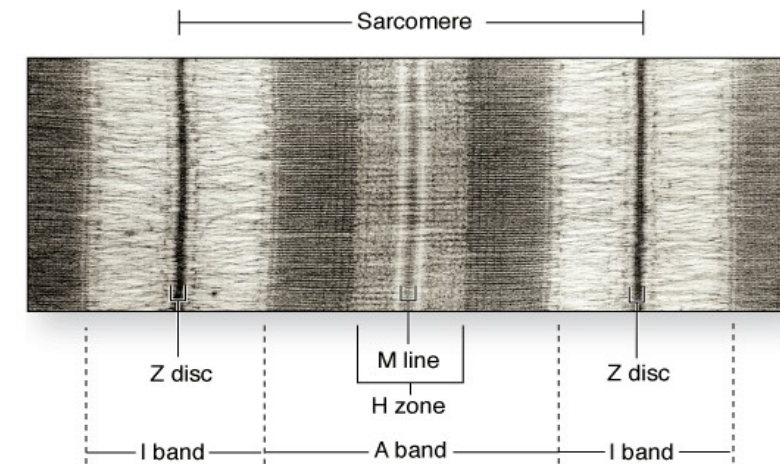


1- Myofibrils

- Contractile threads longitudinally arranged 1-2 μm in diameter
- Each myofibril shows **dark band** {**a**nisotropic = **A** band } and **light band** {**i**sotropic = **I** band}.
- The dark bands are arranged over each other in the adjacent myofibrils and also the light bands.
- This arrangement gives the appearance of transverse **or cross striations**.
- Each myofibril is formed of large numbers of **myofilaments (thick and thin)**



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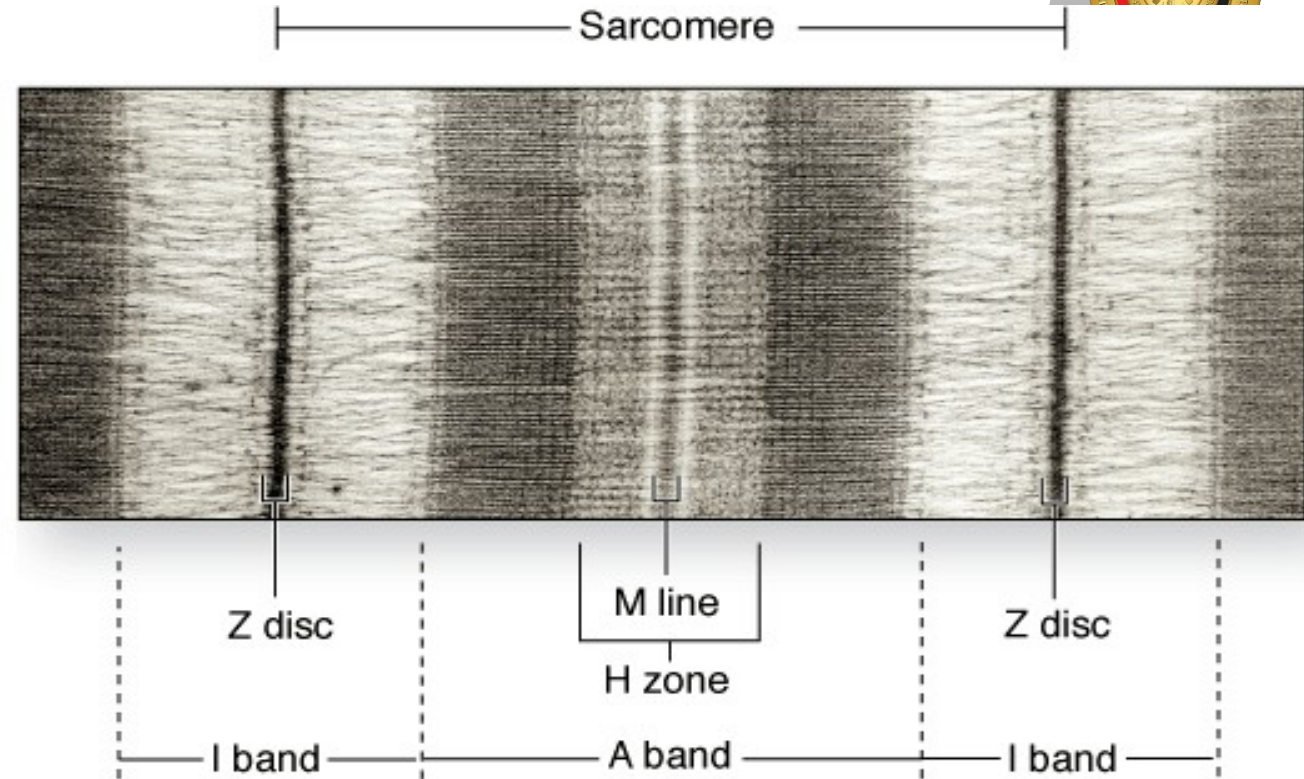


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Sarcomere:

- It is the **functional contractile** unit of sk.m.
- It is the **distance bet. 2 successive Z line.**



It is formed of:

1. Dark band {A band}: It is formed of both **myosin & actin.**

✓ **H zone** (lighter area in the middle of A band) contains **myosin** only.

✓ **M line** is a dark line at the center of H zone {hold thick



Sarcomere (cont.):

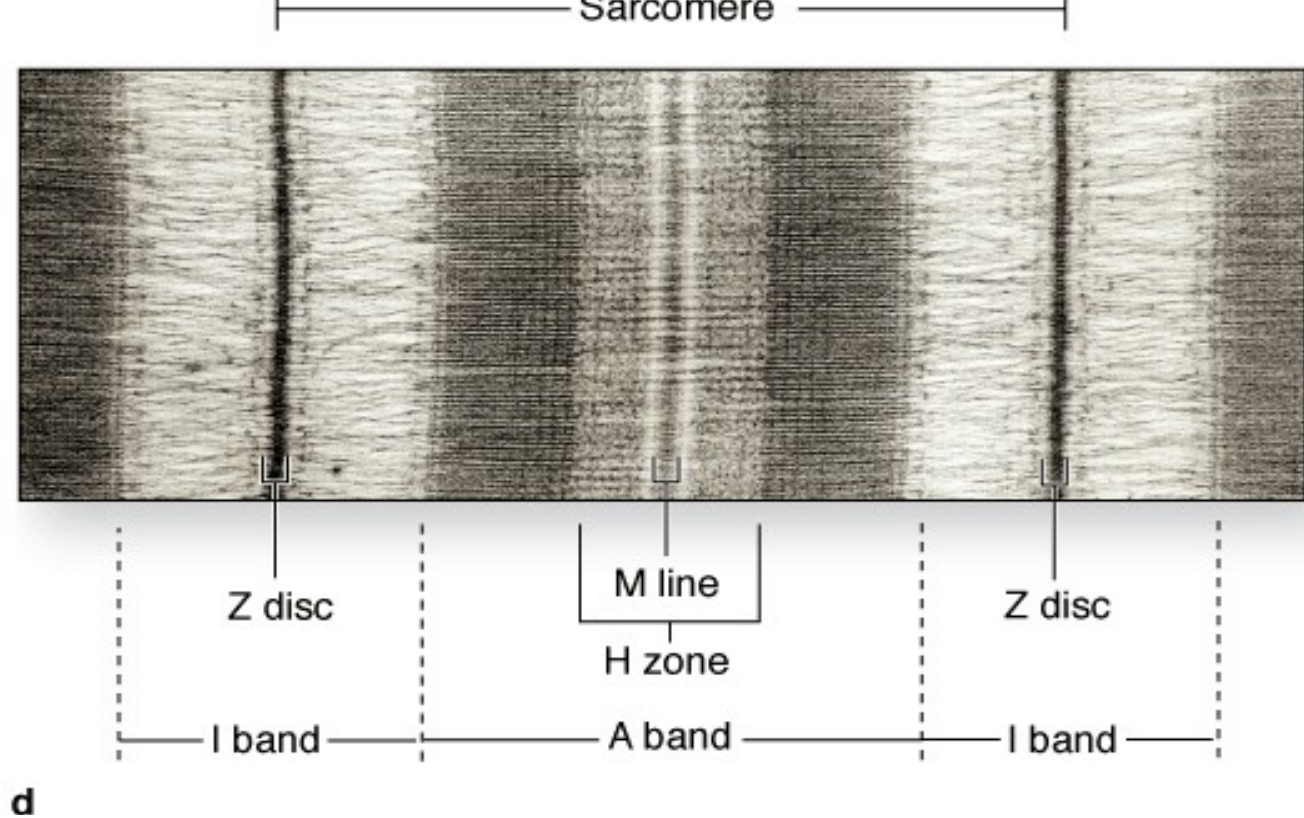
2. Light band (2 halves of I band):

- It is formed of actin filament.
- Actin is anchored to **Z line** (by prot.

α actinin and Nebulin) but not reaching the middle.

3. Z line:

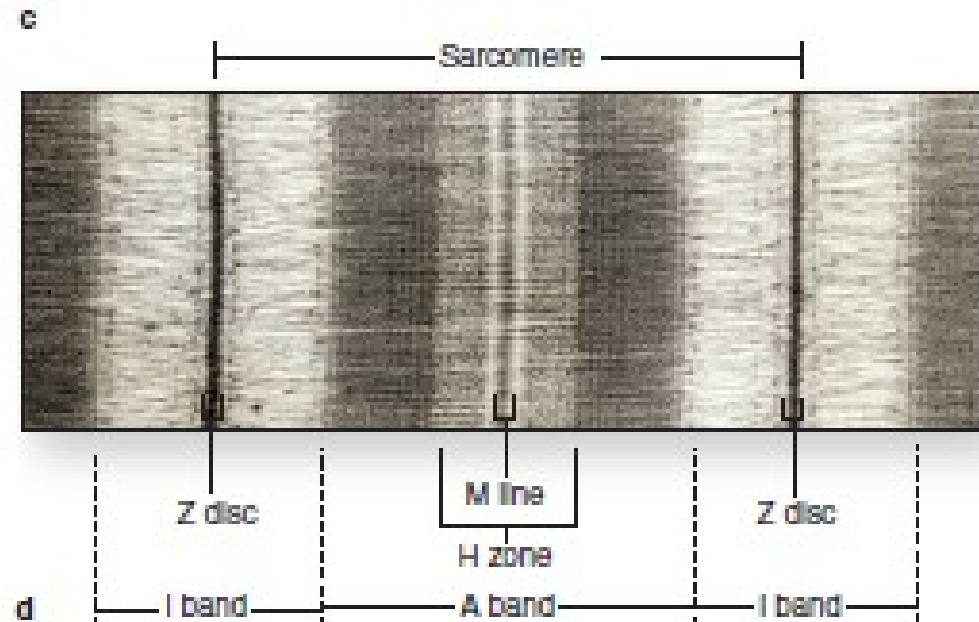
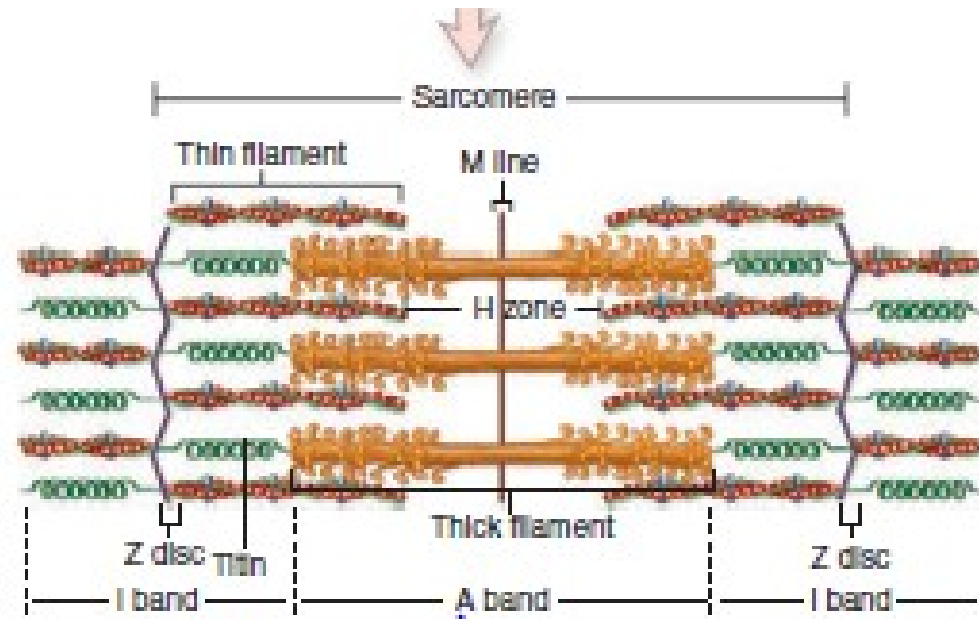
- It is dense line bisecting **I band**



Sarcomere

1-Actin filaments attach to z line by [α actinin](#) and [Nebulin](#)

2- Myosin filaments attach to z line [by Titin](#)



Types of myofilaments



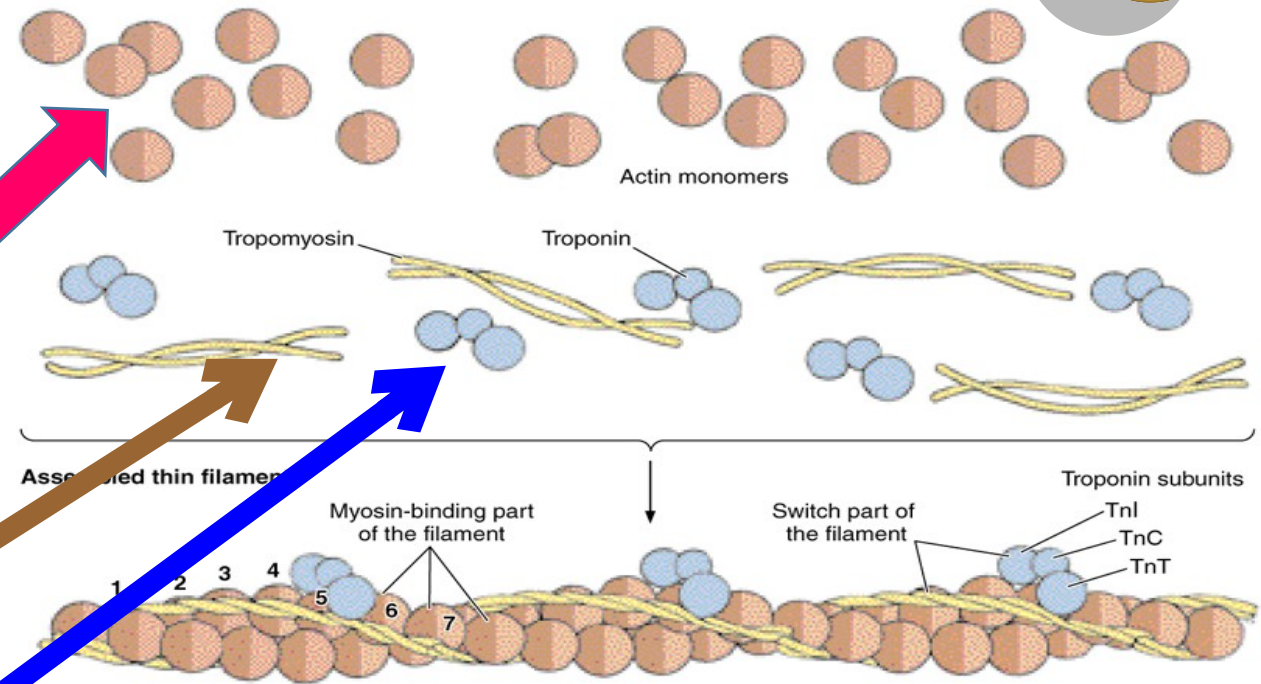
1. Thin filament {actin}:

- It is **1 μm** in length and **7nm** diameter.

-It is formed mainly of **Actin** protein associated

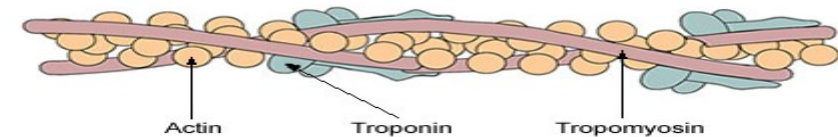
with **Tropomyosin** and **Troponin**

Disassembled components of the thin filament



<https://www.google.com.eg/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=2ahUKEwiErZ3OqpHiAhWLylUKHTovA6cQjRx6BAgBEAU&url=https%3A%2F%2Fslideplayer.com%2Fslide%2F8647123%2F&psia=AOvVaw3efkKwveuAaih6-8hxTGcv&ust=1557590382379326>

Part of a Thin Filament :



Above: Diagrams of Muscle Filaments

<https://lh3.googleusercontent.com/ZQAm3k2A7UnTmFqJJRZURlZrEI593IMPkvE65zlpA888aFH4YTWHhLQ4ZmluFHptMtQ=s170>





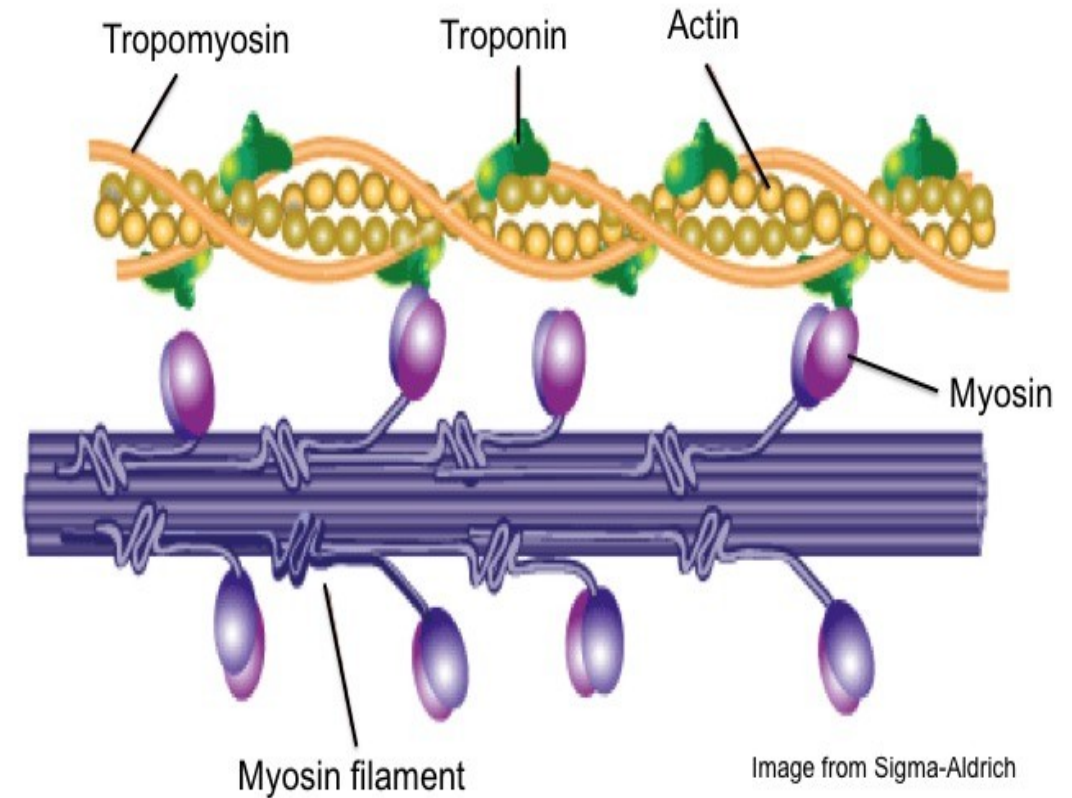
2. Thick filament {myosin}:

-It is **1.5 μ m** in length and **15nm** Diameter.

-It extends in the **A band** only

-It is formed of double headed

golf-club like shape



<https://www.onlinebiologynotes.com/wp-content/uploads/2017/03/actin-and-myosin>





• 2. Thick filament (cont.):

- The thick filament is formed of bundles of myosin molecules. Each myosin molecule possesses a **head** and a **tail** regions resembles a golf club.
- The **globular head** has **2 specific binding sites**:
 - **ATP binding sites** (ATPase activity) and **Actin binding site**.

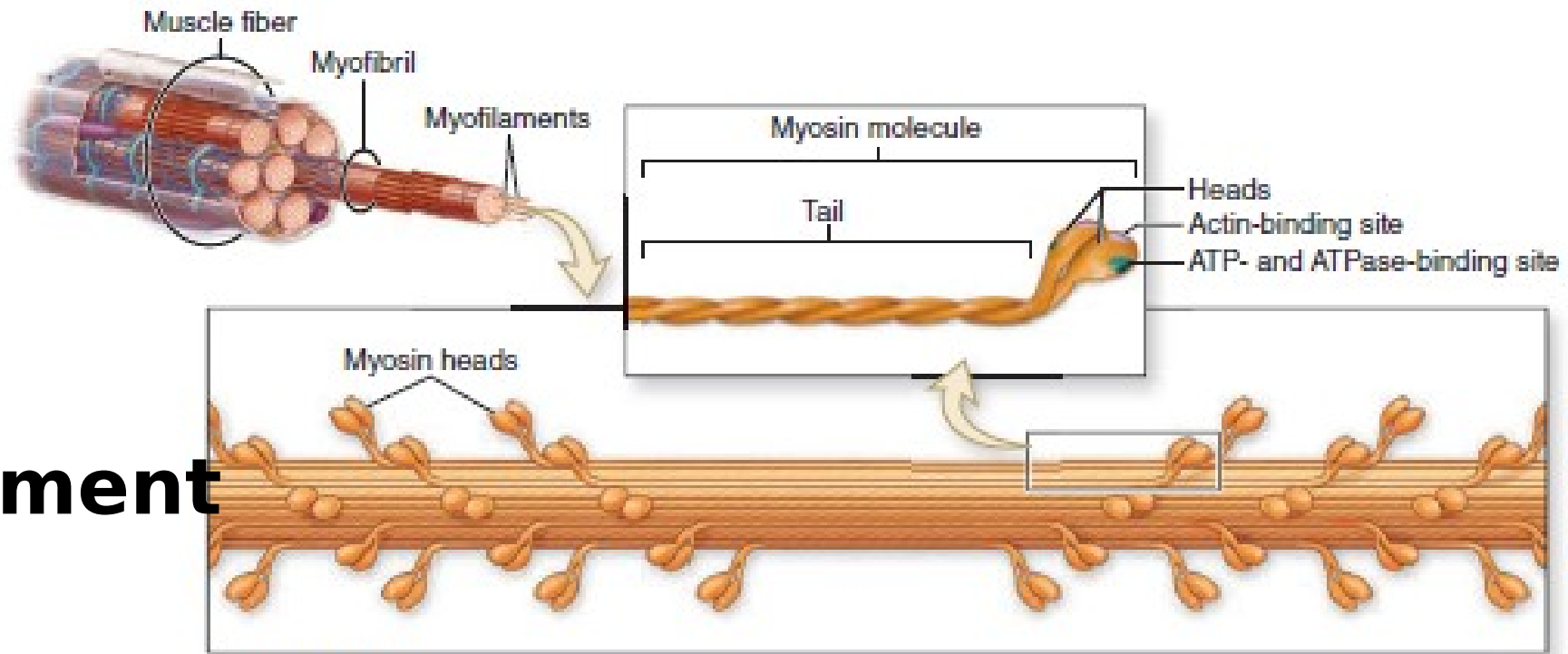


(a) Myosin molecule

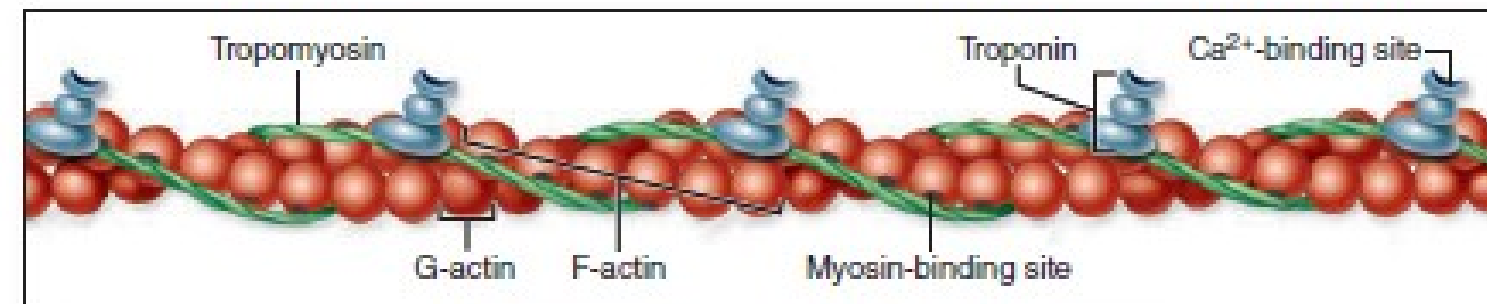
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a Thick filament

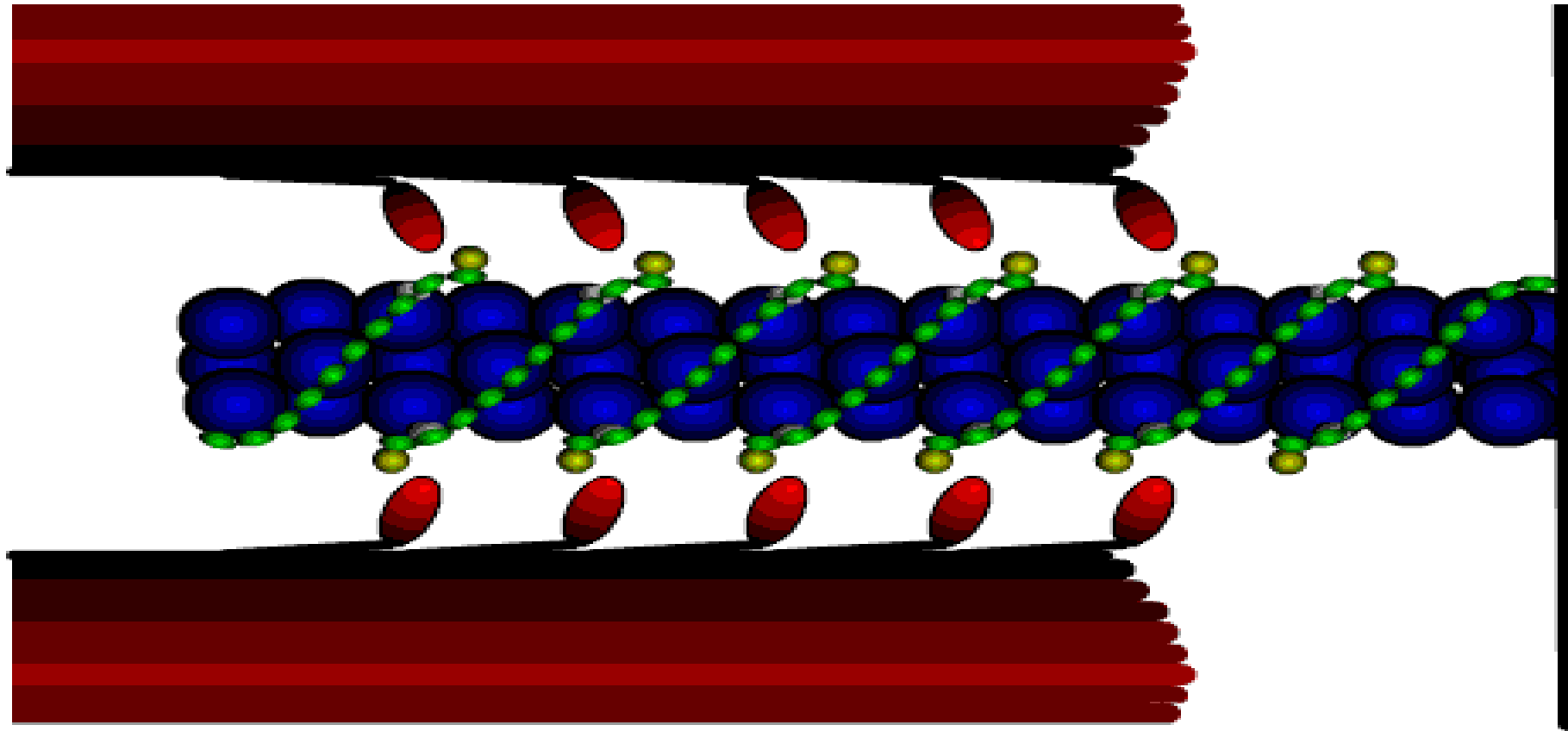


b Thin filament

Myosin filament

Actin filament

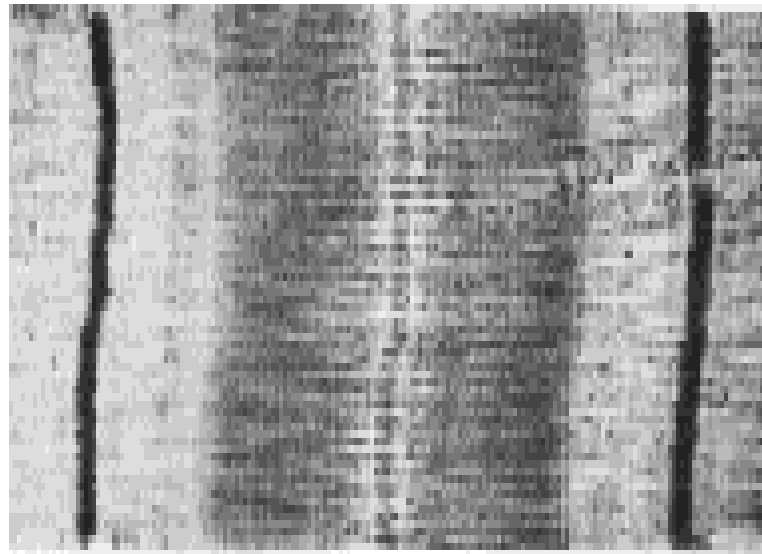
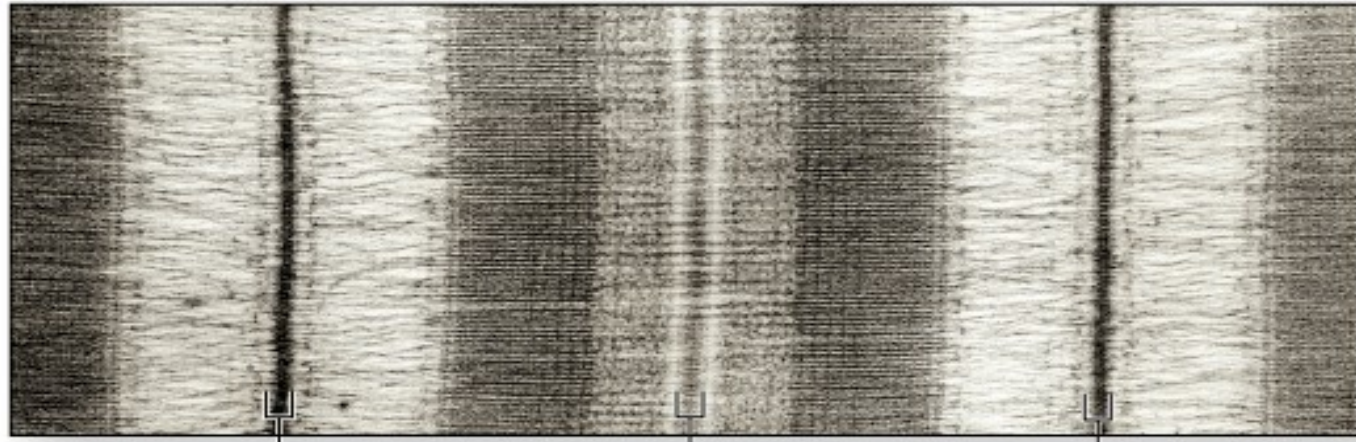




The action potential inhibits the calcium pumps, and calcium escapes from the **sarcoplasmic reticulum**.

<https://www.google.com.eg/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=2ahUKEwjL8sudrJHiAhWsxoUKHUYBCGgQjRx6BAgBEAU&url=%2Furl%3Fsa%3Di%26rct%3Dj%26q%3D%26esrc%3Ds%26source%3Dimages%26cd%3D%26ved%3D%26url%3Dhttps%253A%252F%252Fwww.pinterest.com%252Fpin%252F313140980314838818%252F%26psig%3DAOvVaw19XZHdEz3rtiQZFtKj7TAE%26ust%3D1557590825618452&psig=AOvVaw19XZHdEz3rtiQZFtKj7TAE&ust=1557590825618452>





Sarcomere



Lecture Quiz



The contractile unit of skeletal muscle fibers is:

- A) I band.
- B) Sarcolemma.
- C) The myofibrils.
- ☒ D) Sarcomere.



Thin filaments attach in which of the following?



- A) I band.
- ☒ B) Z line.
- C) H zone.
- D) M line.



Which of the following is detected in the A band of the sarcomere?



- A. Only myosin filaments
- ☒ B. Both actin & myosin filaments
- C. Only actin filaments
- D. Alpha actinin protein



Key Points



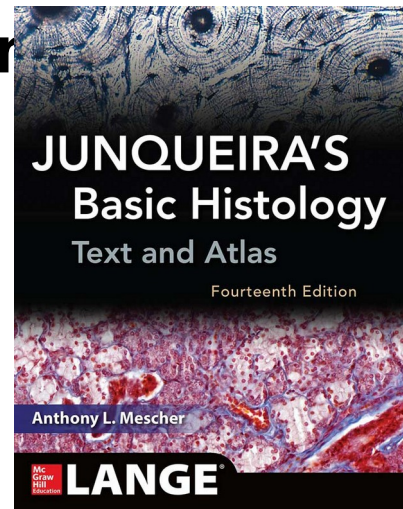
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SUGGESTED TEXTBOOKS

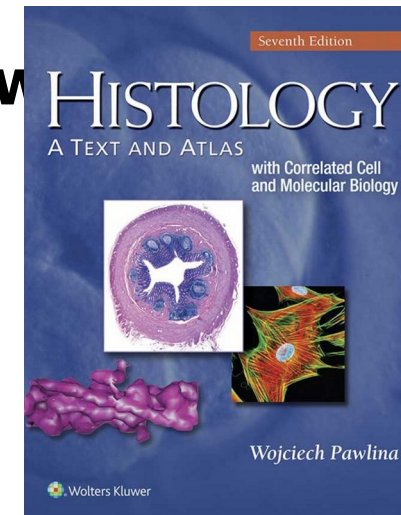


1. Junqueira's Basic Histology: Text and Atlas, Fourteenth Edition by Anthony Mescher (2016)

2. Histology a text and atlas with correlated cell and



by W. Pawlina



THANK
YOU

